

ADVANCED THREE-DIMENSIONAL METHOD FOR SHUTDOWN DOSE RATE CALCULATIONS

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The method was originated in designing activity for International Thermonuclear Experimental Reactor (ITER) and Demonstration Fusion Power Reactor DEMO projects. Fusion reactor has much heterogeneity, such as port of remote access, channels with diagnostic apparatus. In order to obtain precise value of shutdown dose rate it is necessary to take into account depositions to dose rate from surrounded radioactive reactor parts of residual gamma particles.

The principal feature of the method is performing calculations in three consistent stages: radiation 3-D transport during nuclear device operation, calculations of decay gamma sources, and decay gamma transport from sources in the chosen 3-D geometry with shutdown dose rate or afterheat as a result. Realization of the method is performed by means of interface code between radiation transport and activation programs. The neutron and decay radiation transports analyses were carried out by the Monte-Carlo MCNP program, the decay activation analysis - by the inventory program FISPACT. The interface automated the process of creation of input files for separate MCNP and FISPACT calculations on the basis of preliminary adjustment given by the user. The interface allows optimizing the process of activation analysis by revealing dominant sources of radioactive radiation. The developed interface essentially reduces time needed for calculations.

The general methodology of shutdown dose rate calculation has been invented for solving some particular tasks of radiation environment estimation in irradiated by neutrons nuclear devices, regardless of geometry complexity. Methodology works for any times after reactor shutdown, for any materials. The code is modernized and combined all advantages obtained in international work on development shutdown dose rate codes for fusion devices. One of the acceleration features of code algorithm is use multi-box Monte-Carlo sampling procedure in stage of decay gamma transport. Method realized in code was successful applied to ITER and DEMO fusion reactor projects.